what deductions may be drawn from particular facts. In short, they are to be regarded as sign-posts pointing out some of the highways and byways of geological inquiry, but leaving the reader to perform the journey in his own fashion."

At the outset it is made clear that, though some localities supply more material than others, even the most unpromising are far from barren of interest to those who have eyes to see. The necessary equipment is fully described. In addition to the "cheese-taster" mentioned on p. 29, the portable boring-apparatus devised by Belgian geologists has been found useful. So much stress has been already laid on the value of mapping, that it will be enough to say that, in the author's opinion, the geologist "acquires by it a thoroughness of grasp attainable in no other way." It would have been well if the meaning of contour lines, and the way in which hill-shading is used to denote the shape of the surface, had been treated of more fully. The illustrations of the sinuosities of outcrop across uneven ground, on p. 101, are beautifully distinct, but nothing is said as to the value of models in making clear this point to the beginner. Of course they tell most when he makes them himself: a little modelling clay can generally be obtained; but, in default of better material, an apple or turnip can be made to do good service. In the very handy approximate rule, on p. 116, for determining the thickness of a bed when its dip and the breadth of its outcrop are known, it is not stated that the surface on which the breadth is measured must be horizontal; or, if it be an inclined plane, we must substitute for dip the sum or difference, as the case may be, of the dip of the bed and the inclination of the plane to the horizon. The error committed in using this rule for a dip of 5° is a little over 4 per cent. in defect; it decreases as the dip increases up to 30°: for that angle the rule is accurately true. For dips over 30° the rule gives the thicknesses too great; the error increases rather rapidly with the dip, and at 45° amounts to 6 per cent.; for a dip of 50° it is nearly 9 per cent.

The great value of the book consists in this: from beginning to end it embodies the experiences of one who has spent a lifetime in field-work, and so it is full of "wrinkles" which could not possibly have been picked up in any other way. Most of these anyone who has in him the making of a field-geologist would sooner or later have found out for himself; but it is no small gain to the beginner to be put on the right track to start with, and to have his instructions conveyed with the life and freshness that practical acquaintance can alone give. The present writer feels proud that in one respect he can claim even a more extended experience than the author of the book: the latter, apparently, has never been suspected of being an incendiary (see p. 20), a fate which once befell him who pens this notice.

A. H. GREEN.

THE LAND OF THE LAMAS.

The Land of the Lamas: Notes of a Journey through China, Mongolia, and Tibet. By William Woodville Rockhill. With Maps and Illustrations. (London: Longmans, Green, and Co., 1891.)

MR. ROCKHILL has for so long a time taken special interest in Tibet that he is able to speak of it as his "life hobby." Accordingly, when, in 1884, he was attached to the U.S. Legation at Peking, he looked forward with pleasure to the chance of exploring the country; and he began to make the best of all preparations for the undertaking by studying the Tibetan language. At this he worked for four years, during which he also gave some time to the study of Chinese.

In the winter of 1888 he resigned his post of Secretary of Legation, and made ready for his long-anticipated journey. He determined to enter Tibet from the north, and started from Peking on December 17. The choice of this route made it necessary for him to make in the first instance for Lan-chou, the capital of the province of Kan-su; so he arranged with a cart firm to supply him with two carts, with two mules to each, to take him there in thirty-four days. For every day over this they were to pay him two taels, he giving them the same amount for every day gained on the date agreed upon. This plan worked admirably, and he reached his destination two days ahead of time. The distance was 1350 miles.

From Lan-chou, Mr. Rockhill advanced to Hsi-ning, the residence of the Chinese Imperial Controller-general of the Koko-nor, an official known to the Tibetans and Mongols as the Amban. As this magnate was strongly opposed to foreigners, Mr. Rockhill made off from Hsi-ning as soon as possible, going to Lusar, a village near Kumbum. Kumbum is a great religious centre, and he was fortunate enough to be present on the 12th of the first moon, when the Chinese in every village and town of the empire celebrate the dragon festival. After looking through one of the temples, he and those who accompanied him walked round it, keeping it on the right hand—"a mode of showing respect for sacred things observed in all lamaist countries." At a lamasery in the neighbourhood, where he found a native who had taught him Tibetan at Peking, he had much pleasant talk with various lamas. These authorities were, he says, "immensely amused" by what he had to tell them about esoteric Buddhism and the Mahatmas.

Mr. Rockhill's final preparations were made at Tankar, the most westerly border town in that part of Kan-su. From this place, with his men, he set out on March 24, 1889, and was soon across the frontier. His intention was to visit Lh'asa; and had he succeeded in carrying out this plan, his narrative would probably have taken rank among the foremost modern books of travel. Unfortunately, the difficulties in the way proved to be insuperable, and he was obliged to content himself with a much less ambitious enterprise. The first country traversed by the party was Koko-nor, their route taking them past the northern shore of the great lake from which the region derives its name. This lake is some 230 miles in circumference, and its altitude is about 10,900 feet above sea-level. Looking at it from a low pass to the north-east, Mr. Rockhill describes it as "a glistening sheet of ice, stretching as far as the eye could reach to the west, and bounded to the south by a range of high, bleak mountains with snow-tipped peaks." To the north and west of the lake there is fine grazing-land, which is watered by many streams. Here nomads find excellent camping grounds in swales and hollows, which afford protection from violent west and north-west winds.

After leaving Koko-nor, the party passed in a southerly direction through Ts'aidam, crossing the Timurté

Mountains, beyond which they entered the desert of Koko Beileh. Starting from the village of Shang, in Ts'aidam, Mr. Rockhill explored a district which Prjevalsky did not find it convenient to visit. Here he followed the course of the Yohuré, on the left bank of which a range of mountains culminates in a peak which Mr. Rockhill estimated to be between 17,000 and 18,000 feet above sea-level. This peak he called Mount Caroline. The district was everywhere "literally alive with game," yak and wild asses being particularly plentiful. Of the Mongols of Ts'aidam, Huc and Prjevalsky have given very unfavourable accounts. Mr. Rockhill found them honest and hospitable; and he says they are much more devout Buddhists than the Koko-nor Tibetans. Among the latter, the laity "do not bother themselves about praying, thinking that they pay the lamas quite enough to do all that is necessary for their good," whereas the Ts'aidam Mongols "are continually mumbling prayers, twirling prayer-wheels, or perhaps doing both at the same time." At Shang a pole supporting two prayer-wheels was attached to the roof of nearly every house. The wheels were put in motion by the wind, which was caught by a simple arrangement of wooden cups fixed on the ends of horizontal sticks, and looking like our anemometers.

From Ts'aidam the party entered North-Eastern Tibet, and here they traversed for the most part a bleak country until they were some way beyond Jyékundo. The country between the range to the south of Alang-nor and the source of the Yellow River has an average altitude of about 14,500 feet; and at this height the horses and dogs soon showed signs of great fatigue. "We felt no brighter than the animals," says Mr. Rockhill; "our clothes seemed to weigh tons, our guns loaded us down, and walking, even on the level, was such a violent effort that perspiration poured down our faces." They were repeatedly warned that it would be impossible for them to cross the Dré Ch'u or upper Yang-tzu Kiang. The passage, however, was effected without serious difficulty. At the point where they first saw it, the river was of a beautiful blue colour. It was about 120 yards wide and 20 feet deep, and flowed swiftly between high, bare, reddish mountains. South of the Dré Ch'u they crossed the Zonyik Valley (altitude, 16,300 feet), at the head of which they saw twelve argali, a kind of sheep which is said to be not uncommon in the wilder gorges along the river. The snow was so deep, and any exertion so exhausting, that Mr. Rockhill did not try to get a shot at them. Beyond this valley the party came to Taglung-la, (altitude, 16,650 feet), the highest pass crossed in the course of the whole journey.

Jyékundo proved to be a pretty place, nestling at the foot of a high, steep hill crowned with the brightly coloured walls of a lamasery. After the fatigues the party had undergone, Mr. Rockhill wished very much to spend a week or two at this village; but the abbot of the lamasery, who was the chief of the district, was so bitterly hostile that they had to depart in haste. During the first day's journey beyond this point the country remained bare and bleak; but when, on the following day, they entered the Dren-kou valley, which leads down to the Dré Ch'u, the scenery "changed as if by magic." They found themselves in a fertile and picturesque glen, where juniper and pine trees grew on the mountains, while by the roadside were plum, gooseberry, honeysuckle, and other shrubs, the fragrance of their blossoms filling the air. A brook flowed between banks covered with soft green grass "powdered over with little white and pink flowers." During the remainder of the journey Mr. Rockhill was often troubled by the lamas, but in other respects his difficulties were less formidable. The route passed through many villages, and he often has occasion to express admiration for the charm of the scenery. Advancing in a south-easterly direction, he came to Dérgé, the richest agricultural and manufacturing region of Eastern Tibet, and the most densely populated. It is especially famous for the excellence of its metal-work. Mr. Rockhill spent some days at Kanzé, the chief city of the Horba country, the inhabitants of which seemed to him the best-looking people he had seen in Tibet. Lu, the Chinese official stationed at Kanzé, warned him that he might encounter serious dangers beyond that city, and insisted on his taking an escort of four Chinese soldiers. Talking of wild tribes to the north of the Horba country, this official assured Mr. Rockhill that men in a state of primitive savagery were found in Tibet. Lu himself had seen a number of wild men who had been driven out of woods by a forest-fire on the flank of Mount Ka-lo, east of Kanzé. "They were very hairy, their language was incomprehensible to Tibetans, and they wore most primitive garments made of skins. He took them to belong to the same race as the Golok, of whom many lived in caves in a condition of profound savagery." From Jyékundo to Dawo, Mr. Rockhill followed the route which had been taken by Pundit A— K—, or Krishna, in 1882; but from Dawo to Ta-chien-lu he chose a different way, and thus had an opportunity of studying a new section of country, which he carefully describes. At Ta-chien-lu, his travels, so far as Tibet was concerned, came to an end. He had still before him, however, a long journey in China, and of the more striking part of it he gives an excellent account, presenting with special vigour the incidents of a trip down the Yang-tzu Kiang, which had "just enough of danger in it to give it zest."

Mr. Rockhill writes simply and clearly, and geographers will read with interest all he has to say of the more remote regions through which he passed. His remarks on the people are not less valuable. It is stated by Chinese writers of authority that for every family in Tibet there are three lamas, and Mr. Rockhill does not believe that this is an exaggerated estimate. From Jyékundo to Ta-chien-lu, a distance of about 600 miles, he passed forty lamaseries, in the smallest of which there were 100 monks, and in five of them from 2000 to 4000. Their landed property is in many cases enormous, and their serfs and bondsmen swarm. There are four lamaist sects, called by the Chinese, yellow, red, black, and white lamas; but the laity do not attribute much importance to the differences between them. In Eastern Tibet there is also a creed known as "Bön." It represents the pre-Buddhist Shamanism of the country. The "Bönbo" are held in great scorn by the lamas; but as their charge for "beating the drum" is exceptionally low, they are readily invited to the houses of the common people for religious services.

Mr. Rockhill is of opinion that polyandrous marriages, although frequently met with, are not by any means so numerous in Tibet as we have hitherto been led to suppose. Polyandry exists only in agricultural districts, and he suggests that it is maintained there because the tillable lands are of small extent, and every family feels it to be important that the ancestral estate should not be divided. This, however, as he himself points out, can at best explain, not the origin of polyandry, but merely the fact that the custom is still permitted to survive.

We may note that the illustrations are excellent, and that two good maps make it easy for the reader to trace the author's route.

SCIENCE AND BREWING.

A Text-book of the Science of Brewing. By E. R. Moritz, Ph.D., and G. H. Morris, Ph.D. Based upon a Course of Six Lectures delivered by E. R. Moritz at the Finsbury Technical College. (London: E. and F. N. Spon, 1891.)

BREWING is an industry which, as a rule, does not excite the interest in scientific minds that it deserves. The reason is difficult to explain, for there is no industry which involves more problems of general scientific moment, or makes more varied calls on the different sciences. As an illustration—noting very briefly a few points in the manufacture of beer—we have in malting a study of the embryological development of the barley plant, and the secretion and use by the growing embryo of those curious enzymes which render both the carbohydrate and proteid food of the endosperm available; in the mashing, or infusion of malt with water, we meet with the action of the enzyme, diastase, upon starch, involving some of the most complex molecular changes known; and in fermentation, produced both by the Saccharomyces and Bacteria, we have all the interesting difficulties connected with the morphology and zymotic powers of these organisms. It is evident that any technical scientific work on such subjects as those just mentioned, involves questions of the greatest general scientific interest, and touches on points at the extreme limit of our present knowledge; consequently, it is not surprising to find that science owes some most important advances to scientific workers in the field of brewing. For instance, our knowledge of the constitution of starch, and the changes it undergoes during hydrolysis by the action of acids and diastase, is almost entirely due to the researches of C. O'Sullivan and of Horace Brown, both connected with the industry of brewing.

Dealing, then, as the science of brewing does, with some of the most complex problems known, investigations in this field of work carry with them more than ordinary technical interest, and should excite more general interest in the scientific aspect of the industry than seems to be accorded to it at present. A perusal of Drs. Moritz and Morris's "Text-book of the Science of Brewing" has induced us to make these remarks, for contained in this work we find for the first time a lucid and correct account of the important scientific principles involved in the brewing industry, and the work that has been done upon them. Although, of course, mainly written for technical purposes, the authors have treated the whole of their subject in such a manner that the book undoubtedly has a general scientific value beyond the circle of those for whom it is mainly intended. We are sure that anyone wishing to look up such subjects as starch and its transformations, or fermentation, would do well to consult this work, for, apart from the admirable *résumés* of our present knowledge on such subjects, the abundant references given, to the authors quoted, are themselves of much value.

Hitherto there has been great want of a technical guide to the scientific principles of brewing, nothing in the least worthy of such a name having been published; and the unfortunate student of this subject has been compelled to attempt the almost impossible task of collecting his information from a literature scattered far and wide, with no guide to teach him how to do it, or how to select the good from the bad when it was done. His difficulty is now over, we are pleased to say, for in Drs. Moritz and Morris's work we find a technical guide that ranks with the best of those written on any subject, and we feel sure that it will assist in a marked way in spreading a more general knowledge of the real principles of the brewing industry. One aim of the authors has been, not only to lay before their readers the present state of scientific knowledge with regard to brewing, but also by their experience as brewers to draw practical deductions from this knowledge. This part of their subject they have approached in a very fair and impartial spirit, and they have not hesitated to call attention to those points on which knowledge is at present too restricted to justify drawing deductions of any value. Those who are acquainted with the *quasi*-scientific writing that prevails in some of the brewing trade periodicals, will thoroughly appreciate this. We trust that the appearance of Drs. Moritz and Morris's work will raise the general tone of technical brewing literature, an end much to be desired.

In attempting to write a text-book bringing the scientific principles and the practice of brewing together, the authors undertook a difficult task, and one that could only be done by those who have a thorough grasp of both branches of the subject. They have been most successful in their effort, and we commend their work to the notice of all students of brewing, and to all those brewers who take a rational interest in their own business; such cannot fail to derive much benefit from a careful study of it.

A THEORY OF GRAVITATION.

Fresh Light on the Dynamic Action and Ponderosity of Matter. By "Waterdale." (London: Chapman and Hall, 1891).

THE original aim of this work was the discovery of some reason, other than the hypothesis of attraction, to account for the gravitation of one body towards another.

The writer thus takes up the subject of gravitation where it was left by Newton two hundred years ago. The "Principia" concludes with these words—

"Rationem vero harum Gravitatis proprietatum ex Phænomenis nondum potui deducere, et Hypotheses non fingo. Quicquid enim ex Phænomenis non de-